PLANT ITEM MATERIAL SELECTION DATA SHEET

R10664181

ISSUED BY
RPP-WTP PDC

RLD-VSL-00165 (LAB)
Hotcell Drain Collection Vessel

- Design Temperature (°F)(max/min): 240/-20
- Design Pressure (psig) (max/min): 15/7
- Location: Lab

Contents of this document are Dangerous Waste Permit affecting

Operating conditions as stated on attached Material Selection Data Sheet

Options Considered:

- Vessel contains contaminated liquid effluent at normal operating temperatures less than 92°F.
- Mixing will be provided by pumps and eductors. Solid accumulation at bottom of vessel is anticipated. Wash rings are available for flushing.
- Dilute acid is available for cleaning vessel internals.

Materials Considered:

Material (UNS No.)	Relative Cost	Acceptable Material	Unacceptable Material
Carbon Steel	0.23		X
304L (S30403)	1.00		X
316L (S31603)	1.18		X
6% Mo (N08367/ N08925/N08926)	7.64	X	
Alloy C-276 (N10276)	~ 10	X	
Alloy C-22 (N06022)	11.4	X	
Ti-2 (R50400)	10.1		X

Recommended Material: UNS N08367, N08925 or N08926 (6% Mo alloys) or better

Recommended Corrosion Allowance: 0.040 inch (includes 0.024 inch corrosion allowance and 0.004 inch erosion allowance)

Process & Operations Limitations:

- Develop flushing/rinsing procedure

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EXPIRES: 12/07/07

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This bound document contains a total of 5 sheets.

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PLANT ITEM MATERIAL SELECTION DATA SHEET

Corrosion Considerations:

a General Corrosion
In this vessel, the normal pH conditions and temperatures are such that 316L stainless steel would be acceptable if no chlorides are present. However, because of the expected halide concentration, a 6% Mo alloy is recommended.

Conclusion:
A 6% Mo alloy is recommended.

b Pitting Corrosion
Chloride is known to cause pitting in acid and neutral solutions. At the lower end of the stated pH range, with the expected halide concentrations, 316L is a marginal choice. A 6% Mo alloy or better is needed.

Conclusion:
Localized corrosion, such as pitting, is common and would be a concern at the expected halide levels. Under the stated conditions, a 6% Mo alloy is the minimum recommended.

c End Grain Corrosion
End grain corrosion only occurs in metal with exposed end grains and in highly oxidizing acid conditions.

Conclusion:
Not likely in this system.

d Stress Corrosion Cracking
The exact amount of chloride required to cause stress corrosion cracking is unknown. In part this is because the amount varies with temperature, metal sensitization, and the environment. But it is also unknown because chloride tends to concentrate under heat transfer conditions, by evaporation, and electrochemically during a corrosion process. Hence, even as little as 10 ppm can lead to cracking under some conditions. Generally, as seen in Sedriks (1996) and Davis (1987), stress corrosion cracking does not usually occur below about 140°F. With the maximum fluid temperature stated at 92 °F and with a large concentration of chlorides, 316L is not recommended. A more resistant alloy such as 6% Mo alloys or better will be needed.

Conclusion:
A 6% Mo alloy or better is recommended.

e Crevice Corrosion
Non-negligible amounts of solids are expected to accumulate at the bottom of the vessel. With the proposed operating conditions, 304L and 316L are not acceptable. A 6% Mo alloy or better is recommended. In addition, see Pitting.

Conclusion:
A resistant alloy such as a 6% Mo is recommended.

f Corrosion at Welds
Other than pitting or crevice corrosion, corrosion at welds is not considered a problem in the proposed environment. 6% Mo alloys must be welded with a high molybdenum filler metal such as NiCrMo-3.

Conclusion:
Weld corrosion is not considered a problem for this system.

g Microbiologically Induced Corrosion (MIC)
The proposed operating conditions are suitable for microbial growth. However, liquids received should either be treated or DIW so the possibility of infection is small.

Conclusion:
MIC is not considered a problem.

h Fatigue/Corrosion Fatigue
Not expected to be a concern.

Conclusions
Not believed to be a concern.

i Vapor Phase Corrosion
Vapor phase corrosion is not expected to be a concern.

Conclusion:
Not a concern.

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j Erosion
Velocities within the vessel are expected to be low. Erosion allowance of 0.004 inch for components with low solids content (< 2 wt%) at low velocities is based on 24590-WTP-RPT-M-04-0008.

Conclusion:
Not a concern.

k Galling of Moving Surfaces
Not applicable.

Conclusion:
Not applicable.

l Fretting/Wear
No contacting surfaces expected.

Conclusion:
Not applicable.

m Galvanic Corrosion
No dissimilar metals are present.

Conclusion:
Not applicable.

n Cavitation
None expected.

Conclusion:
Not a concern.

o Creep
The temperatures are too low to be a concern for metallic vessels.

Conclusion:
Not applicable.

p Inadvertent Addition of Nitric Acid
Higher chloride contents and higher temperatures usually require higher alloy materials. Nitrate ions inhibit the pitting and crevice corrosion of stainless alloys. Furthermore, nitric acid passivates these alloys; therefore, lower pH values brought about by increases in the nitric acid content of process fluid will not cause higher corrosion rates for these alloys. The upset condition that was most likely to occur is lowering of the pH of the vessel content by inadvertent addition of 0.5 M nitric acid. Lowering of pH may make a chloride-containing solution more likely to cause pitting of stainless alloys. Increasing the nitric acid content of the process fluid adds more of the pitting-inhibiting nitrate ion to the process fluid. In addition, adding the nitric acid solution to the stream will dilute the chloride content of the process fluid.

Conclusion:
The recommended materials will be able to withstand a plausible inadvertent addition of 0.5 M nitric acid.

PLANT ITEM MATERIAL SELECTION DATA SHEET

References:

1. 24590-LAB-MVC-RLD-00003, Rev. A, *Material Selection Data Sheet*
2. 24590-WTP-RPT-M-04-0008, Rev. 2, *Evaluation Of Stainless Steel Wear Rates In WTP Waste Streams At Low Velocities*
3. Davis, JR (Ed), 1987, *Corrosion, Vol 13*, In "Metals Handbook", ASM International, Metals Park, OH 44073
4. Sedriks, AJ, 1996, *Corrosion of Stainless Steels*, John Wiley & Sons, Inc., New York, NY 10158

Bibliography:

1. 24590-LAB-3YD-RLD-00001, *System Description for the Radioactive Liquid Waste Disposal System (RLD) for the Analytical Laboratory.*
2. Davis, JR (Ed), 1994, *Stainless Steels*, In ASM Metals Handbook, ASM International, Metals Park, OH 44073
3. Hamner, NE, 1981, *Corrosion Data Survey*, Metals Section, 5th Ed, NACE International, Houston, TX 77218
4. Jones, RH (Ed.), 1992, *Stress-Corrosion Cracking*, ASM International, Metals Park, OH 44073
5. Koch, GH, 1995, *Localized Corrosion in Halides Other Than Chlorides*, MTI Pub No. 41, Materials Technology Institute of the Chemical Process Industries, Inc, St Louis, MO 63141
6. Phull, BS, WL Mathay, & RW Ross, 2000, *Corrosion Resistance of Duplex and 4-6% Mo-Containing Stainless Steels in FGD Scrubber Absorber Slurry Environments*, Presented at Corrosion 2000, Orlando, FL, March 26-31, 2000, NACE International, Houston TX 77218.
7. Uhlig, HH, 1948, *Corrosion Handbook*, John Wiley & Sons, New York, NY 10158
8. Van Delinder, LS (Ed), 1984, *Corrosion Basics*, NACE International, Houston, TX 77084

PLANT ITEM MATERIAL SELECTION DATA SHEET

OPERATING CONDITIONS

BY: Budhi N. Kapoor
DATE: 04/16/2003
SUBJECT: Process and Materials Selection Data for Hotcell Drain Collection Vessel (RLD-VSL-00165)

CALCULATION SHEET

PROJECT: RPP-WTP
JOB NO.: 24590
CALC NO: 24590-LAB-MVC-RLD-00003
SHEET REV: A
SHEET NO: ~~10~~ 11 BNK 4/21/03

Materials Selection Data

Document No 24590-LAB-MVC-RLD-00003, Rev A

Component (Name/ID) Radioactive Liquid Disposal Vessel (24590-LAB-MV-RLD-VSL-00165)

System RLD-VSL-00165

Fabrication/Construction

Material	
Heat treatment	
Mechanical treatment	
Surface finish	
Cleaning	
Marking	
Corrosion allowance	

Transportation

Protection	

External Environment

Chemistry	
Relative Humidity	

Operations

Chemicals	Unit	Cold Startup	Normal Operation*	Standby/Idle	Cleaning	Accident
		Note 1		Note 2		
Aluminum	g/l		1.71E-02			
Bromide	g/l		1.65E-06			
Chloride	g/l		9.17E-01			
Fluoride	g/l		1.22E-01			
Hydroxide	g/l		1.83E-01			
Iron	g/l		8.42E-03			
Nitrate	g/l		1.08E+00			
Nitrite	g/l		9.86E-03			
Phosphate	g/l		1.82E-03			
TOC*	g/l		9.56E-02			
Sulfate	g/l		1.90E-01			
Undissolved solids	g/l		See comments (1)			
Particle size/hardness	µm (##)		NA			
Other ($NaMnO_4$, Hg, etc)	g/l		1.49E-05 (Hg)			
Carbonate	g/l		3.41E+00			
pH	-		6 to 8			
Dose rate, α, β/γ (inside)	Rad		See comments (2)			
Temperature	°F		See comments (3)			
Velocity	fps		NA			
Vibration			NA			
Time of exposure	#		NA			

* Based on Calc. No. 24590-LAB-MVC-RLD-00003, Rev A

\# - % of total; ## - use Mho scale

Assumptions:

Remarks:

Notes
Note 1: Assume same as normal operations minus radionuclides
Not 2: Same as normal operation

Comments:
(1) Total Solids accumulation per month at the bottom of the C5 vessel (RLD-VSL-00165) = 0.20 in
(2) Activity in C3 vessel: 137-Cs: 1.62E-03 Ci/gal and 90-Sr: 1.80E-03 Ci/gal
(3) The minimum, normal, and maximum fluid temperatures will be approximately 50°F, 78°F, and 92°F, respectively.

Prepared by: B. Kapoor BNK
Dates 4/17/03

Checked by: S. Rueff
SMR 4-17-03

Approved by: Abdul Dada
[signature] 4/22/03

☐ Black Cell

☐ Flushing

* List expected organic species. Potassium hydrogen phthalate, Ammonium hydrogen oxalate, Ethanol, Glacial acetic acid, Chloramine-T

* Use maximum of 2 significant figures